

Environmental Company

AIR TOX

Environmental Solutions For Today's Industries

Midwest Air Products Co. Inc.
Enforcer III Composite Mesh Pad Mist Eliminators

EMISSIONS TEST PROTOCOL

Superior Plating Co.
Southport, Connecticut

Prepared for:

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Superior Plating Co.*

Prepared by:

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Air Tox Project No. 96029

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1.0 INTRODUCTION

Air Tox Environmental Company, Inc. of Willington, Connecticut has been retained by Superior Plating of Southport, Connecticut to perform compliance testing on three MAPCO Enforcer III composite mesh pad (CMP) mist eliminators servicing multiple hard chrome electroplating processes. The purpose of this testing is to fulfill the compliance testing requirements of the Chromium NESHAP MACT emission rate standard of 0.015 mg/dscm.

The test program described within this protocol will be performed on September 22 - 24, 1998. One of the CMPs will be tested each day using two Method 306A sampling trains. Please note that each unit has two exhaust stacks. The compliance program will be completed under the supervision of Dan Aune of Air Tox and Richard Durazzo of Superior Plating.

Section 2.0 of this protocol presents the scope of the sampling program. A description of the process and operations is presented in Section 3.0. Sampling and analytical methodologies, including a detailed description of the sampling train, are presented in Section 4.0. Air Tox's quality assurance plan is detailed in Section 5.0. A copy of the notification of performance test form, calibration sheets, sample field data sheets, and example calculations are contained in the Appendix.

2.0 SCOPE OF THE SAMPLING PROGRAM

The purpose of this testing program is to demonstrate compliance with The National Emissions Standards for Chromium Emissions from Hard and Decorative Chromium Electroplating and Anodizing Tanks, which were published in the Federal Register on January 25, 1995. Testing will also verify compliance with the requirements of Connecticut's "Maximum Allowable Stack Concentration" (MASC) for chromium.

Superior Plating utilizes three composite mesh pad (CMP) mist eliminators to control chromium emissions from 21 hard chrome electroplating tanks. The chromium mist generated by the tanks is pulled from each tank through double-sided lateral exhaust hoods and then through ducting to the CMPs. Two 20,000 acfm fans are utilized to pull the vapors through each CMP and to exhaust vapors out through twin 36" diameter stacks. Schematics of the ducting and CMP configurations are included with this protocol. The testing program described in this protocol will demonstrate that chromium emissions from the six CMP stacks (two per unit) are less than 0.005 mg/dscm.

Chromium sampling and analysis will be carried out on each of the six stacks in accordance with EPA Method 306A (60 FR 4986). The test program will also utilize EPA Reference Methods 1 and 2. Each of CMP's stacks will be tested simultaneously using two sampling trains while CMP fans are operating at their maximums. One unit will be tested each day during the three day testing program. As specified in Method 306A, three two-hour sample tests will be completed for each stack. Analysis of the test samples will be performed by an accredited laboratory for total chromium. The total chromium content and test data will then be used to calculate the total emission rate for each test in mg/dscm, $\mu\text{g}/\text{acm}$, and mg/hr. The results of each stack's three sample runs will then be averaged and compared to the emissions rate limit of 0.005 mg/dscm.

Pressure-drop measurements of the CMPs will be taken at 10 minute intervals during the testing. The pressure-drop measurements established during the testing will also be used to verify continual compliance.

3.0 PROCESS AND OPERATIONS

Superior Plating is a custom job shop that performs hard chrome electroplating for the aircraft industry, gun manufacturers, machinery, cylinders, bearings, and other miscellaneous parts where corrosion resistance, wear or hardness is required. Parts in general are various alloys of steel and aluminum.

Please refer to Table 3.1 for a listing of each of Superior Plating's hard chrome electroplating tanks and their specifications. Superior Plating's maximum cumulative rectifier potential is 897 million ampere-hours per year, thus classifying their facility as a large source. The rectifier amperages during testing will be documented and presented in the performance test results report. Rectifier amperage data will be read from the ampere meters on each rectifier. This data will be taken on 10 minute intervals during testing. Please refer to Table 3.2 for a listing of each tank and the expected amperages during testing. These expected amperages represent what Superior considers maximum production.

Table 3.1 Tank Specifications

Tank Number	Tank Length (inches)	Tank Width (inches)	Tank Height (inches)	Fluid level (inches)	Volume (gallons)	Rectifier Amperage	CrO3 Conc. (g/l)	Vented to CMP
18	84	36	48	42	550	10000	240-270	SC-3
19	156	48	60	54	1750	9000	250-280	SC-3
20	120	36	36	31.5	589	7500	375-420	SC-3
21	48	48	48	45	449	1500	275-300	SC-3
23	288	42	48	42	2199	12500	250-280	SC-3
24	84	36	96	90	1178	9000	250-280	SC-3
31	84	36	48	42	550	4000	240-260	SC-2
32	84	36	48	42	550	9300	240-260	SC-2
33	84	36	72	66	864	7500	240-260	SC-2
34	84	36	48	42	550	3800	240-260	SC-2
37	144	36	48	42	943	15000	240-270	SC-2
43	84	36	48	42	550	4500	240-260	SC-1
44	144	36	48	42	943	7500	240-260	SC-1
45	120	36	48	42	785	4800	250-280	SC-1
46	120	36	48	42	785	9500	275-300	SC-1
55	36	36	120	112	628	4000	250-280	SC-1
56	84	36	48	42	550	4500	275-300	SC-1
60	84	36	144	138	1807	9000	240-260	SC-1
61	84	36	144	138	1807	12000	240-260	SC-1
62	*NO RECTIFIERS CONNECTED, USED FOR CHROME RECYCLING ONLY.							SC-1
63	*NO RECTIFIERS CONNECTED, USED FOR CHROME RECYCLING ONLY.							SC-1
64A	24	48	52	46	229	4500	240-260	SC-2
64B	120	48	48	40	997	3000	325-425	SC-2
Cummulative Rectifier Amperage						152400		

Table 3.2
Expected Amperages during Testing

Tank Number	Total Rectifier Capacity	Expected Amperage During Testing	% of Total
18	10000	1600	16%
19	9000	3000	33%
20	7500	600	8%
21	1500	120	8%
23	12500	6000	48%
24	9000	3500	39%
31	4000	1000	25%
32	9300	1500	16%
33	7500	4000	53%
34	3800	1000	26%
37	15000	2500	17%
43	4500	500	11%
44	7500	2000	27%
45	4800	500	10%
46	9500	2800	29%
55	4000	800	20%
56	4500	1200	27%
60	9000	2300	26%
61	12000	2000	17%
62	0	0	
63	0	0	
64A	4500	2100	47%
64B	3000	1400	47%
	152400	40420	27%

4.0 SAMPLING AND ANALYTICAL METHODOLOGIES

Chromium sampling and analysis will be carried out in accordance with EPA Method 306A (60 FR 4986). The testing program will also utilize EPA Reference Methods 1 and 2.

4.1 Apparatus

Measurements of stack gas velocity and volumetric flow rate will be taken using a S-type pitot tube and an incline manometer. A protractor will be attached to the pitot tube for cyclonics verification. Stack gas temperatures will be taken with an digital thermometer and K-type thermocouple.

The sampling train probe assembly consists of a thick-wall polypropylene probe nozzle sheathed within a section of 0.75 inch steel conduit. The exposed tip of the polypropylene probe is beveled. The probe assembly is attached to an "mason jar" impinger train assembly by a flexible polypropylene sample line.

The sample train impinger assembly consists of three one-quart "mason jars" with Teflon vacuum seal lids. The sample line is connected to a polypropylene impinger tube that passes through the first jar's vacuum seal lid and terminates 3/16 inches from the bottom of the jar. This first jar contains 250 ml of 0.1 N sodium hydroxide. The first jar's vacuum seal lid has an outlet that is connected to the second jar via a similar polypropylene impinger tube that terminates 1 inches from the bottom of the empty second jar. The outlet of the second jar is attached to the third jar containing silica gel via an impinger tube terminating 1/2 inches above the bottom of the third jar. The third jar outlet is attached to approximately 10 feet of polypropylene tubing that in turn is attached to a Method 5 stack testing module.

A Method 5 stack testing module will be used to maintain and measure sample airflow. The ΔH will be set at the $\Delta H@$ for the module to maintain the airflow of 0.75 cfm. Pre-test and post-test calibration documentation for modules will be included in the test results report.

As mentioned earlier, the reagent used in the sampling train is 0.1N sodium hydroxide. A polypropylene wash bottle containing this sodium hydroxide solution will be used in all wash-down and recovery procedures.

4.2 Procedures

4.2.1 Measurement of Stack Gas Velocity

Sample port and traverse point locations will be determined in accordance with EPA Method 1. Diagram 4.1 illustrates the location of the

1. DUCT TO BE TYPE 4/TYPE 1 ONLY PVC.
2. ALL DUCT ON ROOF TO BE TYPE 8 WHITE PVC.
3. INSTALL DAMPERS 12" UP IN RISERS.
4. 3/4" THK X 3" WIDE FLANGES ON EQUIPMENT.
5. CUSTOMER RESPONSIBLE FOR HANGERS, STANCH SUPPORTS, SCORNER SUB-BASE, FAN SUB-BASE, ROOF OPENINGS AND FLASHINGS.

1. DUCT TO BE TYPE 4/TYPE 1 ONLY PVC.
2. ALL DUCT ON ROOF TO BE TYPE 8 WHITE PVC.
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5. CUSTOMER RESPONSIBLE FOR HANGERS, STANCH SUPPORTS, SCORNER SUB-BASE, FAN SUB-BASE, ROOF OPENINGS AND FLASHINGS.

sample ports. Measurements of ΔP and cyclonic flow will be taken at each of the twelve traverse points in ports 1 and 2. The ΔP measurements will be taken using the S-type pitot tube and incline manometer. The flow angle measurements will be taken at each traverse point using a inclinometer attached to the pitot tube. These measurements will be taken once at the beginning of the test day.

The ΔP numbers will be input into a computer spreadsheet that will calculate the "point sampling times" according to equation 306A-1 of the method. The flow angles will also be averaged to verify the average is less than 20 degrees thus verifying that cyclonics are within acceptable limits.

4.2.2 Sampling

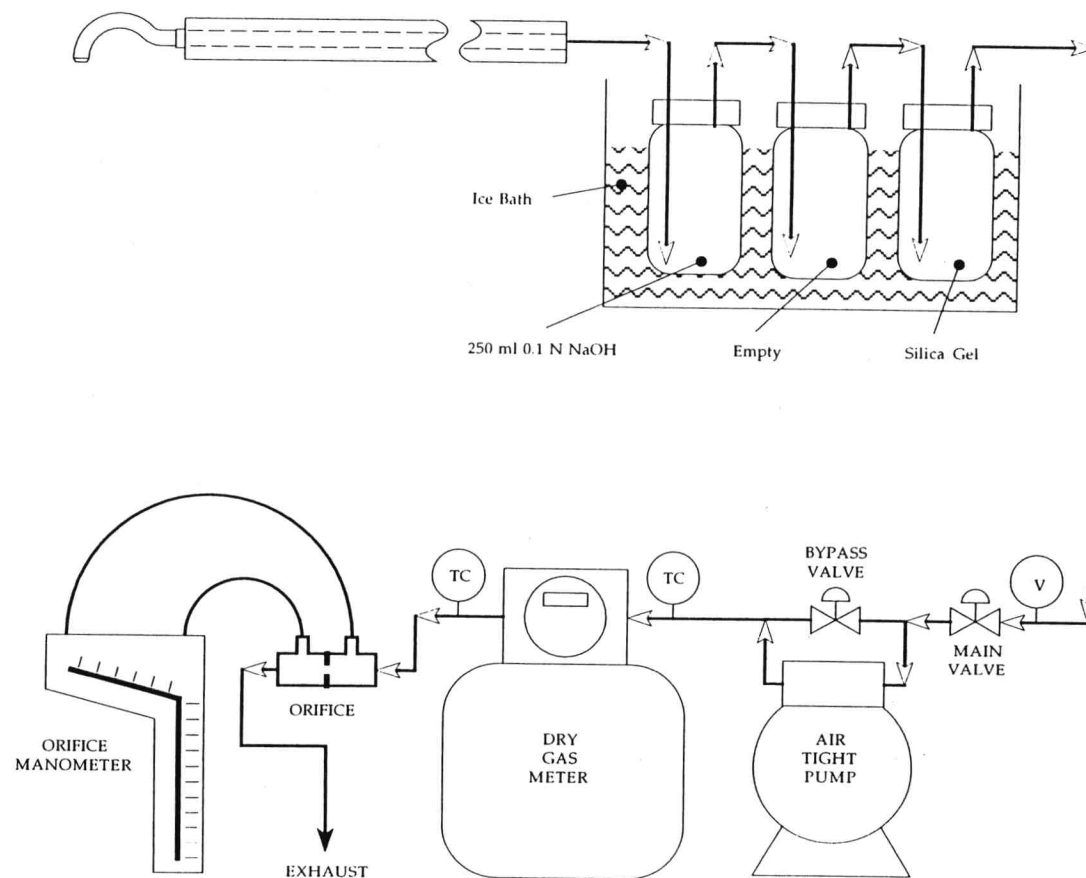
The sampling train will be assembled as shown in Diagram 4.2. The first impinger jar will be pre-rinsed with 0.1N sodium hydroxide and then charged with 250 ml of 0.1N sodium hydroxide. The second impinger jar will also be rinsed with the 0.1N sodium hydroxide and then left empty. The third impinger jar will be charged with silica gel. After charging, the three impinger jars will be iced down. The sample train will be leak checked prior to each testing period.

After leak checking the sampling train, the probe/nozzle will be inserted into the stack at port 1, traverse point 1. The vacuum pump will be turned on and a correct vacuum pressure will be set immediately. The probe nozzle will be held at each traverse point for the time interval calculated for that point. At the end of the first port traverse, the vacuum pump will be turned off until the probe is moved into port 2. Port 2 will be traversed in the same manner as the first port. The overall duration of each sample run will be two hours. Each point sampling time will be calculated per the following equation.

$$\text{Minutes at point } n = \frac{\sqrt{\text{Point } n \Delta P}}{(\sqrt{\Delta P})_{\text{avg}}} \times 5.0 \text{ minutes}$$

After the sample train passes a post-test leak check, the sample will be recovered. The first jar will function as the sample container jar. The outside of the first impinger stem will be rinsed into the first jar as well as the contents of the second jar and the tube that connects the first and second jar. The probe/nozzle and sampling line are also rinsed into the first jar. This is done by injecting the 0.1N sodium hydroxide into the end of the probe/nozzle and sampling line while drooped between two people and then raising the tubing to force the sodium hydroxide down the tube to be released into the first impinger jar. This will be repeated three times. The collected sample will be sealed in the jar and labeled with a sample number. The liquid level will be marked to gauge any sample loss.

Diagram 4.2



KEY:

CUSTOMER:

Superior Plating

LOCATION:

Southport, Connecticut

TITLE:

Method 306A Sampling Train

AIR TOX ENVIRONMENTAL CO., INC.

165 RIVER ROAD, PO BOX 239

WILLINGTON, CONNECTICUT 06279

DATE MADE:

3/18/97

DATE PRINTED:

DATE REVIEWED:

PROJECT NO.:

DRAWING NO.:

PAGE NO.:

PREPARED BY:

DEA

REVIEWED BY:

APPROVED BY:

4.2.3 Laboratory Analysis

Each of the sampling procedures outlined above will be repeated until three two-hour samples have been collected for each stack. These samples will then be sent to Environmental Health Labs (EHL) of Cromwell, Connecticut. EHL is an accredited laboratory for this type of analysis. In accordance with method 306A, the samples will be analyzed by atomic adsorption spectrophotometry (AA). Prior to being analyzed by the AA, the samples will be digested with acid to concentrate the sample and provide a lower detection limit. The lower detection limit for the AA is <2.5 ug based on an average sample volume of 500 ml. EHL's "Standard Operating Procedures" (SOP) have been reviewed and approved by Jack Harvanek of the U.S. EPA.

5.0 QUALITY ASSURANCE

The project manager is responsible for implementation of the quality assurance program as applied to this project. Implementation of quality assurance procedures for source measurement programs is designed so work is done:

- ♦ By competent, trained individuals experienced in the methodologies being used.
- ♦ Using properly calibrated equipment.
- ♦ Using approved procedures for sample handling and documentation.

Measurement devices, pitot tubes, dry gas meters, and thermocouples are uniquely identified and calibrated with documented procedures and acceptance criteria before and after each field effort. Records of all calibration data are maintained in the files.

Data are recorded on standard forms. Bound field notebooks are used to record observations and miscellaneous elements affecting data, calculations, or evaluation.

Prior to the test program Air Tox provides calibrations of all pitot tubes, dry gas meters, orifice meters, sampling nozzles, and thermocouples which are used during the test. All calibrations are performed within four months prior to the test date.

Probe and fiber bed temperatures will be ± 25 °F of the specified temperature.

In addition to the test samples, blank samples of reagents will be collected at the test site for background analyses. All blank samples will be analyzed in conjunction with actual test samples. Sampling results will be corrected for these backgrounds if required.

Appropriate sample recovery data will be recorded on the sample identification and handling logs, chain of custody forms and analytical data forms as presented in the Appendix. Recovered samples will be stored in shock-proof containers for storage and shipment for analyses.

Specific details of Air Tox's QA program for stationary air pollution sources may be found in "Quality Assurance Handbook for Air Pollution Measurement Systems", Volume III (EPA-600/4-7-027b).

Appendix

NOTIFICATION OF PERFORMANCE TEST
*(This notification is not required if you do not have to
 conduct a performance test under the regulation.)*

Applicable Rule: 40 CFR Part 63, Subpart N—National Emission Standards for Chromium
 Emissions from Hard and Decorative Chromium Electroplating and Chromium
 Anodizing Tanks

1. Print or type the following for each plant in which chromium electroplating and/or chromium anodizing operations are performed:

Owner/Operator/Title JOHN RAYMOND PRESIDENT
 Street Address LACEY PLACE
 City SOUTHPORT State CONNECTICUT Zip Code 06490
 Plant Name SUPERIOR PLATING COMPANY
 Plant Phone Number (203) 255-1501
 Plant Contact/Title RICHARD DURAZZO
 Plant Address (if different than owner/operator's):
 Street Address SAME AS ABOVE
 City _____ State _____ Zip Code _____

2. Complete the following table. If additional lines are needed, make copies of this page.

Type of control technique	Control System ID #	ID # of tank ducted to control system	Type of tank	Date of performance test
COMPOSITE MESH PAD MIST ELIMINATOR	SC-1	44, 43, 45, 46,	ALL TANKS	9/22/98
		55, 56, 60, 61,	ARE HARD	
		62, 63	CHROME	
COMPOSITE MESH PAD MIST ELIMINATOR	SC-2	31, 32, 33, 34	ALL TANKS	9/23/98
		37, 64A, 64B	ARE HARD	
			CHROME	

NOTIFICATION OF PERFORMANCE TEST
*(This notification is not required if you do not have to
conduct a performance test under the regulation.)*

Applicable Rule: 40 CFR Part 63, Subpart N—National Emission Standards for Chromium
Emissions from Hard and Decorative Chromium Electroplating and Chromium
Anodizing Tanks

1. Print or type the following for each plant in which chromium electroplating and/or chromium anodizing operations are performed:

Owner/Operator/Title JOHN RAYMOND, PRESIDENT
Street Address LACEY PLACE
City SOUTHPORT State CONNECTICUT Zip Code 06490
Plant Name SUPERIOR PLATING COMPANY
Plant Phone Number (203) 255-1501
Plant Contact/Title RICHARD DURAZZO
Plant Address (if different than owner/operator's):
Street Address SAME AS ABOVE
City _____ State _____ Zip Code _____

2. Complete the following table. If additional lines are needed, make copies of this page.

Type of control technique	Control System ID #	ID # of tank ducted to control system	Type of tank	Date of performance test
COMPOSITE MESH PAD MIST ELIMINATOR	SC-3	18, 19, 20, 21,	ALL TANKS	9/24/98
		23, 24	ARE HARD	
			CHROME	

Source Test Form No.1

INTENT TO TEST

CT Department of Environmental Protection, Bureau of Air Management/ E&E, 79 Elm Street Hartford Connecticut 06106-5127

ITT # Assigned: _____

I. Source Information

Person or Persons Responsible for Test

Company: SUPERIOR PLATING
 Source Address: LACEY PLACE
 City&Zip: SOUTHPORT, CT 06490
 Contact: RICH DURAZZO
 Telephone: (203)255-1501

II. Billing Information

CT reg 22a 174 26 (b)

Company: SUPERIOR PLATING
 Billing Address: LACEY PLACE
 City&Zip: SOUTHPORT, CT 06490
 Billing Contact: RICH DURAZZO
 Telephone: (203)255-1501

III. Tester Information

Person Responsible for Test

Company: AIR TOX ENVIRONMENTAL
 Address: 165 RIVER ROAD
 City&Zip: WILLINGTON, CT 06279
 Contact: DAN AJNE
 Telephone: (860)987-5600
 Signature: Dan Ajne Date: 6/18/78
 (Person Performing Source Test)

IV. CT. Registration or Permit No.

V. Identify Equipment and Stack to be Tested:

Town Premise Reg or Permit Stack

THREE DUAL STACK COMPOSITE MESH PAD MIST ELIMINATORS
SC-1, SC-2, SC-3 (SIX STACKS)

I. Gas Stream Sampling Information. Identify all Gas Stream Components to be Sampled.

Gas Stream Components	Sampling Duration		Number of Tests	Expected Concentrations	Brief Description of the test method to be used for each pollutant
	Minutes per point	Total Test Time			
<u>STAL CHROMIUM</u>	<u>TBD</u>	<u>120 MIN.</u>	<u>3 per stack</u>	<u>LESS THAN 0.005 mg/dscm</u>	<u>U.S. EPA METHOD 306A</u>

Chromium Field Data Sheet

USEPA Reference Method 306A

Circular Duct

Facility: _____

Location: _____

Operator: _____

Date: / /

Run No. _____

Stack No. or ID _____

Stack Diameter _____

Pitot Coeff. (Cp) _____

Baro. Press (Pbar) _____ "Hg

Port #	Point No.	ΔP	Cyclonics	Port #	Point No.	ΔP	Cyclonics
1	1			2	1		
	2				2		
	3				3		
	4				4		
	5				5		
	6				6		
	7				7		
	8				8		
	9				9		
	10				10		
	11				11		
	12				12		

Chromium Field Data Sheet

USEPA Reference Method 306A

(2 Hour Test)

Facility: _____

Stack No. or ID _____

Location: _____

Stack Diameter _____ in.

Operator: _____

Calibration Factor (Y) _____

Date: _____

Pitot Coeff. (Cp) _____

Run No. _____

Baro. Press (Pbar) _____ "Hg

Leak rate before run _____ cfm

Leak rate after run _____ cfm

Stack Temp. Start _____ °F

Stack Temp. End _____ °F

Meter Volume Start _____ cu. ft.

Meter Volume End _____ cu. ft.

SAMPLE PORT #1				SAMPLE PORT #2			
Point No.	Time (minutes)	Total Time (minutes)	Meter Temp. (deg F)	Point No.	Time (minutes)	Total Time (minutes)	Meter Temp. (deg F)
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				10			
11				11			
12				12			

Total Sample Volume _____ cu. ft.
(End Volume - Start Volume)

Average Meter Temp. _____ (deg F)

Compliance Test

Calculated Stack Concentration - Chromium

$$C_{Cr(mg/dscm)} = \frac{(M_{Cr})(T_m + 460)}{(499.8)(Y_m)(V_m)(P_{bar})}$$

$$C_{Cr(\mu g/acm)} = \frac{C_{Cr(mg/dscm)} * 1000}{(T_s/528^\circ R) * (29.92/P_{abs}) * (100/(100 - \%H_2O))}$$

$$mg/hr = (C_{Cr(\mu g/acm)} * (Q_{actm} * 0.02832) * 60) / 1000$$

M_{Cr} = Amount of Cr in sample (μg)

T_m = Dry gas meter temperature

Y_m = Dry gas meter correction factor

V_m = Dry gas meter volume (ft^3)

P_{bar} = Barometric pressure

$\%H_2O$ = Percent H_2O

P_s = Static Pressure

Test #1	$C_{Cr(mg/dscm)} = 0.0000$
	$C_{Cr(\mu g/acm)} = 0.00$
	mg/hr = 0.00
	$M_{Cr} = 0$
	$T_m = 80$
	$Y_m = 1$
	$V_m = 90$
	$P_{bar} = 29.00$
	$T_s = 80$
	Assumed $\%H_2O = 2$
	$P_s = 0.03$
	$Q_{actm} = 20000$

Test #2	$C_{Cr(mg/dscm)} = 0.0000$
	$C_{Cr(\mu g/acm)} = 0.00$
	mg/hr = 0.00
	$M_{Cr} = 0$
	$T_m = 80$
	$Y_m = 1$
	$V_m = 90$
	$P_{bar} = 29.00$
	$T_s = 80$
	Assumed $\%H_2O = 2$
	$P_s = 0.03$
	$Q_{actm} = 20000$

Test #3	$C_{Cr(mg/dscm)} = 0.0000$
	$C_{Cr(\mu g/acm)} = 0.00$
	mg/hr = 0.00
	$M_{Cr} = 0$
	$T_m = 80$
	$Y_m = 1$
	$V_m = 90$
	$P_{bar} = 29.00$
	$T_s = 80$
	Assumed $\%H_2O = 2$
	$P_s = 0.03$
	$Q_{actm} = 20000$

Averages:

$$C_{Cr(mg/dscm)} = 0.0000$$

$$C_{Cr(\mu g/acm)} = 0.00$$

$$mg/hr = 0.00$$



CHAIN OF CUSTODY

AIR TOX ENVIRONMENTAL COMPANY, INC.

165 River Road

Willington, CT 06279

PROJECT DESCRIPTION _____

PROJECT NO. Compliance Test

PROJECT NAME _____

FIELD SAMPLE NUMBER	DATE	TIME	COMPOSITE OR GRAB	ANALYSIS REQUIRED	SAMPLING TRAIN	SAMPLE DESCRIPTION	SPECIAL NOTES	SEND TO:
Test 1			Composite	Total Chromium by AA - with digestion	306A	0.1 N NaOH	Please digest sample and perform analysis in accordance with 306A	EHL-Cromwell, CT
Test 2			Composite	Total Chromium by AA - with digestion	306A	0.1 N NaOH	Please digest sample and perform analysis in accordance with 306A	EHL-Cromwell, CT
Test 3			Composite	Total Chromium by AA - with digestion	306A	0.1 N NaOH	Please digest sample and perform analysis in accordance with 306A	EHL-Cromwell, CT
Blank		n/a	Grab	Total Chromium by AA - with digestion	306A	0.1 N NaOH	Please digest sample and perform analysis in accordance with 306A	EHL-Cromwell, CT
Please Fax Results to Air Tox Environmental @ 860-487-5607								
Relinquished by: (Signature)			DATE/TIME	Received by: (Signature)		DATE/TIME		
Relinquished by: (Signature)			DATE/TIME	Received by: (Signature)		DATE/TIME		
Relinquished by: (Signature)			DATE/TIME	Received by: (Signature)		DATE/TIME		
Relinquished by: (Signature)			DATE/TIME	Received by: (Signature)		DATE/TIME		

Method 5 Module Calibration Worksheet
Pre-Test Calibration

Module # Date	2	Run Number				
	4/6/98	1	2	3	4	5
Calibration Orifice #		1	2	3	4	5
Orifice Coefficient (K')		0.446	0.514	0.665	0.938	0.999
Final Vm	(ft ³)	933.77	943.97	954.30	964.70	975.32
Initial Vm	(ft ³)	923.75	933.95	944.10	954.65	965.30
Difference Vm	(ft ³)	10.02	10.02	10.20	10.05	10.02
Inlet Temp.						
Initial	(°F)	69	72	73	78	80
Final	(°F)	73	73	81	78	80
Inlet Average	(°F)	71	73	77	78	80
Outlet Temp.						
Initial	(°F)	68	69	70	72	73
Final	(°F)	69	70	71	73	74
Outlet Average	(°F)	69	70	71	73	74
Average Meter Temp.	(°F)	70	71	74	75	77
Time	(0.00 min)	17.82	15.40	12.33	8.57	8.01
ΔH	("WC)	0.98	1.4	2.15	4.40	5.00
Barometric Pressure	("Hg)	29.70	29.70	29.70	29.70	29.70
Ambient Temp.	(°F)	68	68	69	70	70
Pump Vacuum	("Hg)	20	20	15	15	15
Vm(std)	cu. ft.	9.934	9.919	10.065	9.944	9.901
Vcr(std)	cu. ft.	10.273	10.231	10.588	10.371	10.323
Cal Factor (Y)	-	1.034	1.031	1.052	1.043	1.043
ΔH@		1.649	1.710	1.628	1.691	1.695

Averages

Cal Factor (Y)	1.041
ΔH@	1.674

Pre-Test Calibration: Perform one >10 cf run with each orifice.

Post-Test Calibration: Perform three >10 cf runs with orifice corresponding to average Delta H from test program.

Each Y must be within ±2% of average.

Individual ΔH@'s must be ±0.20 from average.

Method 5 Module Calibration Worksheet
Post-Test Calibration

Module #	2	Run Number		
Date	4/28/98	1	2	3
Calibration Orifice #	-	3	3	3
Orifice Coefficient (K')	-	0.665	0.665	0.665
Final Vm	(ft ³)	131.31	141.32	151.33
Initial Vm	(ft ³)	121.30	131.31	141.32
Difference Vm	(ft ³)	10.01	10.01	10.01
Inlet Temp.				
Initial	(°F)	69	75	80
Final	(°F)	77	80	86
Inlet Average	(°F)	73	78	83
Outlet Temp.				
Initial	(°F)	66	68	70
Final	(°F)	68	70	72
Outlet Average	(°F)	67	69	71
Average Meter Temp.	(°F)	70	73	77
Time	(0.00 min)	12.28	12.23	12.22
ΔH	("WC)	2.2	2.2	2.2
Barometric Pressure	("Hg)	30.02	30.02	30.02
Ambient Temp.	(°F)	72	73	72
Pump Vacuum	("Hg)	20	20	20
Vm(std)	cu. ft.	10.054	9.993	9.923
Vcr(std)	cu. ft.	10.629	10.575	10.577
Cal Factor (Y)	-	1.057	1.058	1.066
ΔH@		1.631	1.624	1.609

Averages

Cal Factor (Y)	1.060
ΔH@	1.621

Pre-Test Calibration: Perform one >10 cf run with each orifice.

Post-Test Calibration: Perform three >10 cf runs with orifice corresponding to average Delta H from test program.

Each Y must be within ±2% of average.

Individual ΔH@'s must be ±0.20 from average.